2 More Sase's on File

# WESTERN UPDATE #77 November 27, 1990

THE WESTERN NEWSLETTER FOR MF, LF, AND VLF EXPERIMENTERS

*Available for business-size 25 cent SASE's, plus $1 per issue (or $10 per year)*
*from: Jim Ericson, 226 Charles St., Sunnyvale, CA 94086-6063*

## ACTIVE EXPERIMENTAL BEACON STATUS (LIST COMPILED NOVEMBER 27, 1990)

| FREQ(kHz) | IDENT | LOCATION | SCHEDULE INFORMATION |
|---|---|---|---|
| 163.8 | FPV | Granada Hills, CA | 24h/7d. |
| 169.94 | NRE | San Diego, CA | 24h/7d. |
| 171.142 | XR3 | Mountain View, CA | 24h/7d. Scott Mawhinney. Ident Change. |
| **175.250** | **X** | **Wheatland, WY** | **24h/7d. Slow BPSK 1/60 baud. See text.** |
| 175.703 | FAW | Orem, UT | 24h/7d. |
| 176.0 | HDO | Morro Bay, CA | 24h/7d. |
| 176.85 | 7FS | Belfair, WA | 24h/7d. |
| 177.75 | CT | Pleasant Gap, PA | 10 baud BPSK. Status unknown. |
| 178.62 | DJ | Los Banos, CA | 24h/7d. |
| 179.00 | MPM | Near Morro Bay, CA | 24h/7d. Alt. 5 min BPSK/CW. |
| 179.54 | WJ | Arleta, CA | On, but intermittent. |
| 180.224 | F | Los Banos, CA | FSK. By request. |
| 181.17 | IZJ | San Gabriel, CA | Daily. Silent 0700 to 1100 UTC. |
| 182.88 | H2 | Descanso, CA | 24h/7d, with occasional outage. |
| 183.160 | PRK | Saratoga, CA | 24h/7d. Dan Smith K6PRK. |
| 183.544 | MEL | San Jose, CA | 24h/7d. |
| 184.016 | EK | Sunnyvale, CA | 24h/7d. |
| 184.39 | HO | Pahoa, HI | By request (Sheldon Remington). |
| 184.43 | V | Sebastapol, CA | 24h/7d. Jim Pelmulder N6PTM. |
| 184.46 | MGX | Fresno, CA | 24h/7d. |
| 184.5 | TEXAS | NW of Ft. Worth, TX | 24h/7d. |
| 185.0 | ZYK | Redway, CA | 24h/7d. |
| 185.4 | PLI | Burbank, CA | 24h/7d. Note QSY. |
| 186.375 | BA | Lancaster, IL | 24h/7d. |
| 187.0 | ELU | Simi Valley, CA | 24h/7d. |
| 187.2 | CAT | Cincinatti, OH | 24h/7d. |
| 187.50 | DCH | Berlin, MD | Schedule unknown. |
| 187.59 | SM | San Jose, CA | 24h/7d. |
| 187.7 | 3 GOATS | Portland, OR | 24h/7d. |
| 190.4 | OHH | Richmond Hill, Canada | Occasional testing. |
| 513.635 | SD | Descanso, CA | 24h/7d. Frank Cathell. |
| 1624.75 | CT | Pleasant Gap, PA | 24h/7d. 5 baud CCW. Clint Turner. |
| 1631.54 | A | Cleveland, N.C. | 24h/7d. Ron Barlow. |
| 1640.0 | EDJ | Stone Mountain, GA | 24h/7d. Bob Confrey. |
| 1648.5 | ABC | Hilton Head, S.C. | 24h/7d. Todd Roberts. |
| 1654.7 | EK3 | Sunnyvale, CA | 24h/7d. Jim Ericson. |
| 1655.2 | CO | Glenwood Springs, CO | Off temporarily. Bob Cutter. |
| 1661.35 | U | San Diego, CA | Nights only. Steve Meyerpeter, KG6BY. |
| 1665.2 | G5 | Palo Alto, CA vicinity | Most nites. Mobile! Herb Vanderbeek. |
| 1671.8 | WJ | Arleta, CA | 24h/7d. W6SZQ Wallie Jones. |
| **1687.4** | **SD** | **Descanso, CA** | **24h/7d. Frank Cathell. New Bcn!** |
| 1688.2 | TUS | Tucson, AZ | KD7QK. 0000 to 1400 UTC daily. |
| 1688.45 | Z2 | 9 Mi. NW San Simeon, CA | Mike Mideke. By request. |

Non-Western listings are beacons currently being copied in the West, or they have SASE's on file with us. **Bold entries indicate recent changes, or new beacons.**

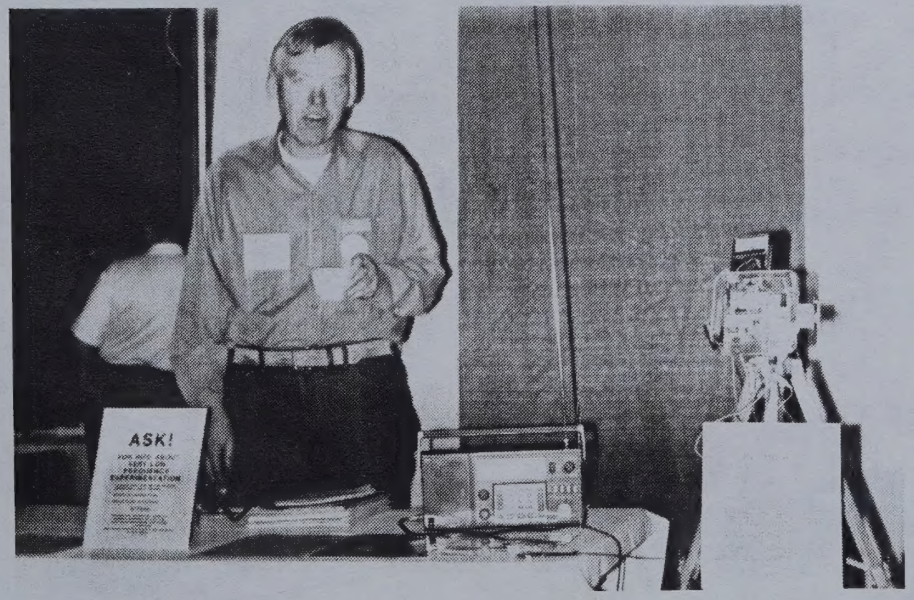
**Please check this listing carefully. Notify me of any errors or omissions.**

## EK NOTES/MAILBAG: by Jim Ericson

Personal activity here has been dominated by work, but we have managed to do a bit of radio stuff. I built up the **Mike Mideke** RS-3 Whistler receiver, and with the help of **Steve Ratzlaff** we managed to find a reasonably quiet listening site about 1 hour drive from home where we put up a semi-permanent 1100 foot longwire and a 50 foot diameter loop. Steve and I are managing to hear some whistlers, but still have a lot of experimenting to do in order to optimize the whole affair. Good fun!

You may notice that the Active Beacon list, and the subscriber listing are both shorter than usual. Subscribers with no SASE's on file were deleted, and beacon listings with no activity reported in the past three months were dumped. Please keep me up to date on who you're hearing so that I can continue to provide current beacon information in WU.

The guy in the photo (holding a cup of coffee) is me -- manning a LowFER booth at the recent October ARRL Pacificon Convention in San Jose, CA. It turned out that we had booth duty anyway for a 75M traffic net (Western Public Service System - 3952 kHz), so we just spread out to an adjacent table and ran a simultaneous LowFER demonstration. The thing on the tripod was a LowFER beacon donated by Mike Mideke...operating on a 9v battery. The beacon sent "B", and was great DX into my RS DX-400 receiver on the table! More than 500 people stopped by the booth to ask about low band experimentation and to pick up a one-page handout describing LowFER activity. About 75 attended an early Sunday morning seminar where I presented a slide and audio summary of the hobby.




**Max Carter** writes, "...Just a note to tell you of the temporary demise of my CW beacon **X**. No, the tower didn't fall down. I'm planning to do some more experiments with super-slow BPSK, and so will be running the transmitter in that mode this season. Frequency is now 175.250 kHz, and the signaling rate most of the time will be 1/60 baud. The ID is "**MAX**" (in ASCII code). I plan to resurrect X next season."

A short note from **Bob (WA1EDJ/4)** in Georgia, "Jim ..Digi Key now sells Signetics NE602 mixer/oscillator chips for $2.82 ea!"

**Keith Olson (7FS)** reports, "At 0750 on 31 UTC October I heard two stations within 100 cycles of 185.5 kHz. One was sending dots and the other, the letter "**A**". Unheard since."

**Greg Raven** of Texas sent along his recent change of address to Florida, and notes, "...The TEXAS beacon is still operational under the care of **Bill Cantrell WD5CVG**. I will be working on a new beacon here on the East Coast. Please keep up the good work on WU." Please check the listing in this issue for other address changes (**Mike Mussler**, **Dave Johnson** - Florida type), and several new subscribers.

**Bill Hooper** of Los Altos, CA sent the following note, along with the scary photograph. "I finally got to set the station up at the Sierra location again for about ten days at the end of October and was able to do some listening in a quiet environment. The temperature was in the teens at night, but the days were nice and I did get to catch some real nice fish! Two things to pass along...one, lightning visited my antenna farm while I was gone (praise the Lord it happened while I was away). You will note from the photo that a discharge from the antenna to a supporting tree resulted in a 25 foot strip of bark being blown off the tree. I don't think it was a direct stroke as there was no damage at all to the antenna and no sign of burning or charring on the tree -- so it was most likely a leader looking for a path; but any charge with enough energy to turn a 25 foot long strip of sap 1/2" wide to steam instantaneously would turn solid-state electronics into slag -- to say nothing of the solid-state operator.

GROUND YOUR ANTENNAS! On a more cheerful note, I was hearing **EK, PRK, SM, and XR3** quite well although conditions were not really good at all. All five are Q5 24 hours a day at the location 25 miles north of Truckee, CA at 7000' altitude."

**Scott Hedspeth (WB4YZA of NC)** says, "My beacon **N35** is off the air, probably not to return. No room for the antenna. Most of my activity has been just as frustrating, only at the other end of the spectrum. Mostly 2304 MHz terrestrial and 2400 MHz Oscar mode S. Doing some work with 10 kHz Omega receiving equipment...going from one extreme to the other. Interested in the GWEN project, so keep us informed. May be an Extra Class ham, but still enjoy Part 15. In fact, currently running 100 mW on 40 Meters with 14 states, 3 countries confirmed and a mere 10 mW on 2304. Enjoy the low power challenge!"

A note from **Chris Catotti** (P.O. Box 183, Valrico, FL 33594-0183) indicating that he will pick up the editorship for the NDB DX'ers Newsletter (previously published by **Sheldon Remington**) beginning in December. Chris solicits comments and material from subscribers (and he has a spreadsheet detailing remaining funds from previous subscribers). The newsletter will be available for photocopy costs plus postage.

That's it for #77! Send us your comments, articles, and photos for the next issue. Happy holidays!

73 de **EK**!

Dear Jim:

Have WU's readers heard of the newsletter ERN?

This is a monthly for experimenters and broadcasters operating on the AM and FM broadcast bands. Most of these people operate, as LowFERs do, under the constraints of Part 15 of the Federal Communications Act. The full name of this publication is Electronics & Radio Hobbyist's Newsletter, but the focus is more narrow than this suggests. I found it in the Pan Com catalog, the place where I first read about LowFERs. They carry literature and kits.

Readers of this publication include so-called pirates, and a column called FCC Happenings contains news items of recent busts: "Pirate FM station KRAZY, Moreno Valley, California, operating at 104.9 MHz, was shut down by the San Diego Field Office." (This 8-watt station, range: 5 miles, had 25 volunteer staff members. Its owner, who saw KRAZY as "an investment," was fined $1,000.) The term pirate is used loosely in ERN and appears in quotes when referring to anyone broadcasting under Part 15. There are recipes for flea-power transmitters but also, in the two issues I read, for 32- and 45-watters.

ERN's devotion to illegals notwithstanding, it has lengthy dissertations on the nuances of Part 15, which limits broadcasters to only 100 milliwatts and only 10 feet of antenna-ground system. ERN says the best location for a 100-milliwatt AM transmitter is "outside on the ground next to the base of a 3-meter vertical wire or pipe as an antenna." Sounds familiar.

Since the Part 15 antenna length includes the height of any capacitive hat, the writer suggests that "one might use three 50-gallon oil drums standing one atop the other." This, he says, would be about three meters high and "would provide a lot of distributed capacity." This Tesla-like thinking (antenna as aerial capacitance rather than radiator) is evident also in an ERN piece on a 100-milliwatt MOSFET amp for an AM xmitter that uses for an antenna an aluminum-wire screen 8 by 2 feet. Total: 10 feet; Part 15 satisfied.

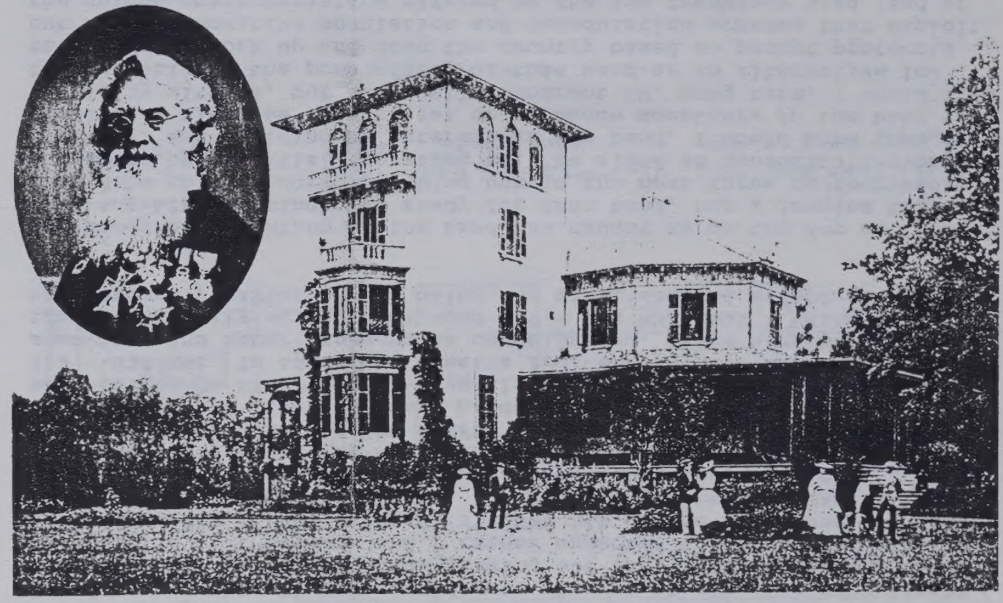
ERN newsletter. Edited by Ernest Wilson, published by Panaxis Productions (Pan Com International), P.O. Box 130, Paradise, CA 95967. $24 per year. Samples $3 each.

Best,

George Trinkaus

P.S. The following may be of interest to a few of your readers. You be the judge:

The Tesla Technology Roundtable meets the third Sunday of the month at noon in Portland, OR at the Northwest Service Center 1819 NW Everett, Room 215.



LOCUST GROVE, Home of Samuel F. B. Morse (1847-1872), Poughkeepsie, New York
YOUNG-MORSE NATIONAL HISTORIC LANDMARK

1 Nov. 1990

To: The Lowdown, Northern Observer, Western Update, LF BBS

Dear Friends,

I received the following electronic mail today:

Frank,
It has been some time since I sent you mail when I said that an LF band for the amateur service was "imminent," so I thought I should let you know the current situation. The news is good.

The New Zealand Association of Radio Transmitters (NZART), the national association of amateur radio users, put a proposal to the administrators of the radio spectrum, the New Zealand Radio Frequency Service (NZRFS), through the NZART Frequency Management and Technical Advisory Group (FMTAG), to gain a portion of the LF spectrum. This proposal was put to NZRFS stressing the experimental nature of operation that would be likely. I was telephoned yesterday by the chairman of FMTAG, who said that this proposal has been agreed to, subject to some specific conditions.

As the conversation was over the phone, I do not have the exact wording of the conditions, but they are basically as follows :

- The band limits will be 165 to 195 kHz.
- Operation by amateurs is on a "temporary until further notice" basis.
- The band limits specified may be used by other services; amateur operation is strictly secondary to all other services.
- Amateur users of this band must tolerate interference from other users of this band.
- There is a maximum EIRP of 5 (five) watts.
- Amateur operation is for holders of the "general" class of amateur licence.
- Applications for operation in this band from appropriately licensed amateurs must be made in writing to the local regional office of the NZRFS.
- The band comes in to effect on 1 November.

NZRFS have also stated that due to the fact that amateur operation is a "designated use" of this band, they specifically request that no band plan should be designed. For the above reason, the band will not appear on the amateur schedule.

So there you have it !

The restrictions should be very easy to live with - to be honest it would take an awful lot of wire (and/or power) to be able to generate 5 watts EIRP, and of course that is not really necessary for the kind of experiments we wish to carry out.

Part of the thanks for the granting of this band must go to yourself for providing an article on USENET on Litz wire that mentioned the US 1750 metre band, and also the excellent material that you sent me. I wrote a draft proposal to FMTAG concerning the band that contained a fair amount of material from your information, and my proposal formed the basis for another paper that FMTAG wrote for NZRFS. Thanks !

When I get a copy of all the relevant paper material I shall send a copy via mail to you.

I didn't expect the band to come through so quickly, and to be honest I had some doubts that it would come through at all. The band limits were proposed by myself after finding out the other users of the spectrum in that region, and I rather expected to be knocked back to 5 kHz or so. The 25 kHz of band is about 14% of the mean band frequency - which is a tremendous result. It should allow us to select a frequency of minimum mutual interference with other services. I think the favourable result is due mainly to the excellent relationship between NZART/FMTAG and the NZRFS, and this relationship is almost certain to bear fruit in other bands as well - for example, in the same letter to NZART, NZRFS have also granted a new band in the band 922 - 927 MHz. In addition, 6 metre frequencies have been expanded somewhat, and other frequencies consolidated. There have been losses too, principally at 2300 MHz, and 610 - 612 MHz, but I think we have have probably maximised the gains and minimised the effect of the losses.

The immediate granting of the band has caught me on the hop as I don't have any transmitting gear ready for that band, but I imagine that I should be able to sort something out in the next three to four weeks. I imagine that initial operation will be aimed at consolidating our presence, and building up interest in the band. I would hope that a local club might be able to set up a beacon somewhere in the band - initially with CW, but eventually coherent CW. Long term, I would like to invcestigate the possibility of this band as an alternative low rate data network up and down the country based on packet protocols but using innovative modulation and demodulation schemes that exploit the unique characteristics offered by the low frequency used (and of course, chosen to minimise the unique problems that the band prsents...).

By the way, I made contact with John Adcock VK3ACA, and it appears there is still a group of LF enthusiasts there with experimental licences, or who are about to get them. I would hope that the move in New Zealand to an amateur LF band will encourage them to do the same thing. Perhaps other countries as well...

Regards,

Stephen McNeill ZL4HG
86 Waddington Drive
Lower Hutt 6301
New Zealand.
----

Stephen McNeill
Image Processing Section
Information Technology Group
DSIR Physical Sciences
Box 31-311
Lower Hutt
New Zealand

Stephen,
Thanks for the news! I will forward it to U.S. and Canadian LF/VLF newsletters. There has been discussion of making 1750m a conventional ham band here, but many people feel that the present restrictions of low power and short antennas are more appropriate in terms of technological challenge and propagation studies. Your higher power limits should make overseas work practicable. I look forward to the first NZ/US contact on LF.

73--

Frank Reid W9MKV

NEWS FROM THE SOUTH: FRANK CATHELL, PO Box 535 DESCANSO, CA 92016

I'VE FINALLY HAD SOME BREAKS OVER THE PAST COUPLE OF MONTHS FROM THE USUAL WORK LOAD TO DO SOME MF AND LF LISTENING AND EXPERIMENTING. WHERE HAVE ALL THE BEACONS GONE THIS YEAR!?? LOWFERS HEARD SO FAR INCLUDE PLI, FPV, MPM, NRE, AZ, IZJ, ELU, WJ AND TRACES OF PRK. THE MEDFER BAND SEEMS TO BE THE REAL "DROUGHT" AREA WITH ONLY U, WJ, G4, G5, Z2, AND RR HEARD. RR, WHICH USED TO BE THE BIGGEST SIGNAL HERE, IS NOW OFF THE AIR. MY OWN MEDFER BEACON SD IS ON TWO FREQUENCIES, 1687.40 kHz AND 513.64 kHz, WITH SIMULTANEOUS KEYING. MIKE MIDEKE HAS BEEN THE ONLY "DX" RECEPTION REPORT OF THE LOWER MEDFER SD. ANY REPORTS OF THIS BEACON WOULD BE GREATLY APPRECIATED SINCE NO SERIOUS PROPAGATION STUDIES OF 100MW SIGNALS HAS BEEN DONE ON THE LOW END YET.

IN EXPERIMENTAL MATTERS I FINALLY WORKED UP ENOUGH NERVE TO OPEN THE LF ENGINEERING L-400B ACTIVE LF WHIP BY TWISTING THE LOWER END CAP OFF WITH A PIPE WRENCH. FORTUNATELY THE PVC CEMENT BROKE LOOSE WITHOUT ANY PROBLEMS. THIS ANTENNA WORKS REASONABLY WELL BUT DOES HAVE SOME INTERMOD PROBLEMS. I DISCOVERED THAT TWO BACK-TO-BACK 1N914 DIODES WERE USED FOR STATIC PROTECTION OF THE J-FET AMPLIFIER. I REPLACED THE DIODES WITH A PAIR OF LOW CAPACITANCE 4.3 VOLT ZENER DIODES WIRED BACK-TO-BACK IN SERIES. LATER TESTS SHOWED THAT THIS GREATLY IMPROVED THE INTERMOD PROBLEMS. THE 1N914'S MUST HAVE BEEN ACTING AS DETECTORS ON STRONG SIGNALS.

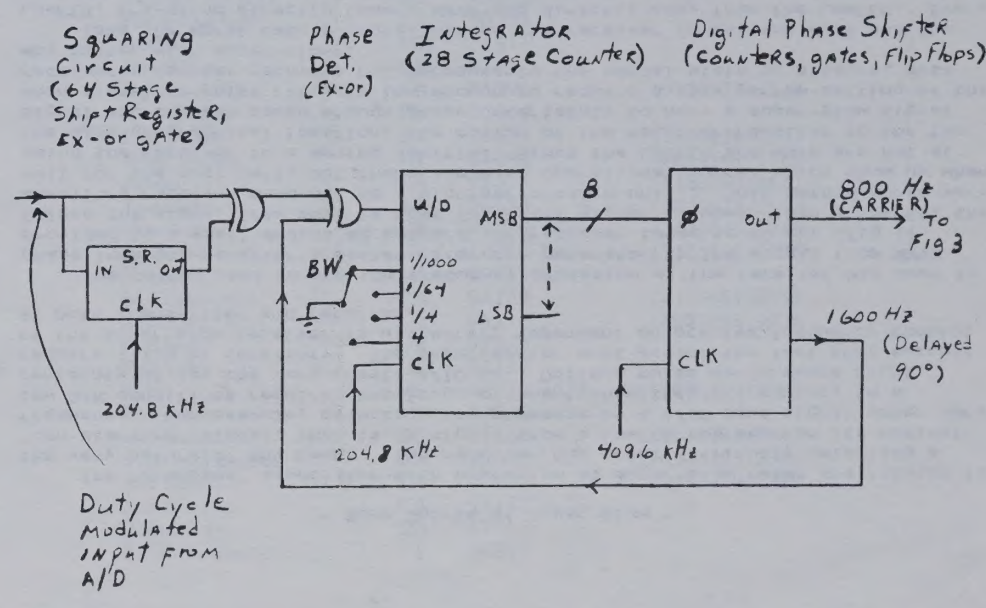
I HAVE ALSO BEEN TRYING TO FIND THE BEST INEXPENSIVE PORTABLE SHORTWAVE RECEIVER FOR LOWFER/MEDFER RECEPTION WITHOUT HAVING TO USE AN EXTERNAL ANTENNA. BELIEVE IT OR NOT THE RADIO SHACK DX-440 (OR SANGEAN ATS-803), WITH SOME MINOR INTERNAL MODIFICATIONS (INCLUDING THE ADDITION OF SOME REAR PANEL TOGGLE SWITCHES), WILL TURN THE EXISTING WHIP ANTENNA INTO A RESPECTABLE ACTIVE WHIP AND THE RECEIVER CAN BE MADE TO PERFORM VERY WELL ON BOTH THE LF AND MEDFER BAND WITHOUT COMPROMISING THE SHORTWAVE OR FM BANDS. WITHOUT THE MODIFICATIONS I COULD HARDLY HEAR SD OR H2 ONE MILE FROM THE TRANSMITTERS. NOW H2 IS EASY Q5 COPY AT 75 MILES AND SD, U, AND RR HAVE BEEN HEARD AT LONE PINE, CA WITH THE RECEIVER SITTING ON THE HOOD OF MY CAR (AT NIGHT OF COURSE). ANYONE INTERESTED IN THE MODIFICATIONS TO THIS RECEIVER PLEASE SEND ME A SASE OR GIVE ME A CALL IN THE EVENING AT (619) 445-8167.

## REPORT FROM THE SUPER-SLOW FRONTIER, Part II
by: Max Carter

Carrier Recovery: The duty-cycle encoded pulse train also drives the carrier phase recovery circuit (Fig 4). This circuit is very similar to the original (Fig. K, Apr. '90 Lowdown). The digital pulse train is first sent through a 64 stage shift register which delays it exactly 312.5 microseconds, the equivalent of one fourth of a cycle at 800 Hz. The register is clocked at 204.8 kHz. The delayed signal is continously compared to (multiplied by) the un-delayed input signal using an exclusive-or gate. The resulting output is a frequency exactly twice that of the input: 1600 Hz. This process is called "squaring".

The signal is then multiplied by the locally generated 1600 Hz carrier using a second ex-or gate, resulting in rectification-to-baseband as above. This signal drives another integrator where filtering occurs just as it does in the data recovery integrator. There are several differences, however; first, there is no reset function - integration goes on continously; second, the circuit includes a switch which can take counter stages out of service in succesion in order to widen the circuit bandwidth as needed; and third, the most significant 8 output lines are used - as opposed to only one in the data recovery integrator. The integrator output drives the digital phase shifter (the lower part of Fig. K in the Lowdown series; also recently improved) which generates the 1600 Hz comparison signal. The integrating counter will eventually settle to an equilibrium count, that is, a count which causes the phase-shift generator to output a signal shifted in phase exactly 90 degrees (quadrature) from the squared input signal. The length of time it takes to reach equilibrium depends on how noisy the signal is. The more noise, the longer it will take. The 800 Hz carrier is derived by dividing the 1600 Hz by 2.

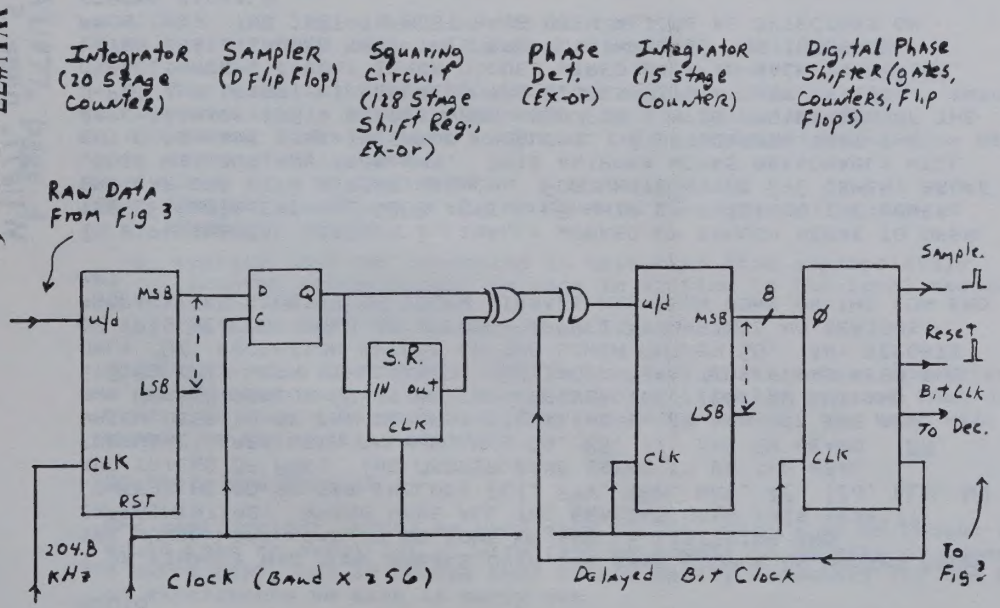
Figure 4: Carrier Recovery



Signaling Interval Recovery: This circuit represents a major departure from the circuit in the Lowdown series (May '90). As you may recall, that circuit utilized a switched capacitor filter to recover signaling interval timing. This time around I thought, in keeping with the digital nature of the rest of the receiver, bit clock recovery may as well be all digital too. The result is a significant improvement in performance, especially at low signaling rates.

As you can see from Figure 5, two separate integrators are used. Integrator #1 receives raw, duty-cycle modulated data from the data detector of Figure 3, integrates and synchronizes it to the slower clocking rate of the following delay register, and strips it of some noise and clocking components in the process. The output of the first integrator sampler is then delayed and multiplied by itself (squared), multiplied by the locally generated bit clock signal and applied to the second integrator. This is where final noise filtering takes place. It works exactly the same way as the carrier recovery integrator of Figure 4. Noise drives the counter up and down randomly while a coherent clock signal will drive it in some specific direction. The 8 most significant output lines of the counter drive a digital phase-shift generator, the output of which is fed back to the input comparator. The output of the phase shifter is the recovered signaling interval clock, or bit clock. This signal is used to generate properly timed sample and reset pulses to operate the data recovery integrator of Figure 3, and is supplied, along with the recovered data from Figure 3, to the decoder chip (Fig. 5, June '90 Lowdown). The phase generator also has free-run and manual synchronization capability.

Figure 5: Signaling Interval Recovery




After a lot of frustration fooling with analog methods of BPSK signal reception, I think performance of the present all-digital design finally begins to approach what is theoretically possible, especially at super-slow rates. While the circuit is certainly not the ulimate in simplicity, as some would like, operation is just about hassle free. Power it up, set a few switches to match frequency, signaling rate, etc., and it works (or it doesn't).

So, how well does it work? I haven't tried any real DX yet, but I did do a little mobile testing in September at 200 miles using one of the heavy-duty rates, 1/10 baud (equivalent to killing a fly with a sledge hammer). I struck me later: How used I have become to pulling into the parking lot of a restaurant or motel, and proceeding to copy, with hardly a thought for the presence or absence of overhead power lines. It works pretty well.



- Some Quirks of Super-Slow -

The "problems" associated with operation at super-slow rates are related to the very nature of the beast. The receiver has great difficulty detecting a "non-standard" signal, that is, a signal from a LowFER not dead-on its nominal frequency. For example, detecting the presence of a 1/10 baud signal under very low S/N conditions requires knowledge of the transmitter's frequency to a certainty of (at the very least) 1/10 Hz. Optimum noise performance might require 1/100 Hz certainty! The experimenter must accept the fact that success of the super-slow receiver is ultimately dependent on precise frequency control at both transmitter and receiver.

The method used to provide frequency precision at the receiver has been to phase-lock the receiver's master reference generator to the signal from WWVB provided by a small dedicated onboard TRF receiver tuned to 60 kHz (Fig 1). [Since the signal from WWVB is some 70 dB (!) higher in power than a LowFER, the auxiliary receiver need not be a high-performance unit.] This method works very well for the most part, but there are some operational quirks which show up when using the receiver in a moving vehicle. Since the LowFER and WWVB are not at the same geographical location, the motion of the receiver relative to the two signal sources can cause enough phase uncertainty to bury a super-slow signal when signal-to-noise ratio is low enough to require a very narrow setting of the receiver's carrier recovery PLL (presumably the normal state of affairs, else why bother with super-slow).

Take the worst case example: Assume the receiver is between WWVB and the LowFER, traveling directly toward WWVB and directly away from the LowFER. Every time the receiver travels a distance of one wavelength at 60 kHz, 5000 meters or about 3 miles, the relative phase of the signal will rotate through 360 degrees. Since the phase-locked carrier generator in the receiver operates at about 3 times the WWVB frequency, each WWVB rotation will generate 3 rotations at the LowFER frequency, or about 1 rotation for every mile of travel. At the same time the phase of the LowFER signal will also be rotating, one rotation for every mile of travel, in the opposite direction. The result is a relative rotation of 2 cycles per mile. If the receiver is traveling at, say, a mile a minute (60 MPH), the relative phase/frequency uncertainty created amounts to about 1 cycle in 30 seconds, or 1/30 Hz. This uncertainty wouldn't seem like much but for the fact that the symbol rate of the super-slow signal we're trying to detect may be near the same order of magnatude. We're talkin' NARROW here. At the bandwidth setting/s required to optomize S/N at the 1/10 baud or less, the PLL simply cannot follow the signal.

Other anomalies associated with the receiver being in motion have to do (I presume) with the changing nature of the propagation paths of the LowFER and WWVB signals over differing terrains. I certainly can't provide a scientific explanation for any of it, but I have noted marked (sometimes violent) relative phase shifts, which can't be explained merely by the relative change in position, when traveling with the receiver through mountainous areas. Such a phase shift occurs, for example, every time the receiver is moved over a known iron ore deposit near here. A study of such anomalies might be of interest to the propagation researchers among us.

So what's the fix? The intrepid experimenter must simply accept the fact that optimim performance can only be achieved when the receiver is not in motion.

Atmospheric factors causing variations in propagation time may also begin to creep in when the receiver is located a great distance from the LowFER. What distance do I consider "great"? I dunno, maybe 1000 miles or so. I haven't noticed any such variations in tests at 550 miles during daylight hours. Exploring these factors, if there are any, also might be of interest to the scientifically minded.

I recently acquired a couple of nice crystal frequency standards (Fair Radio QK1881V-S1) which I hope to incorporate in the receiver design to allow cutting of the WWVB cord at times. This should reduce propagation-caused phase variations somewhat since it would eliminate variations from the WWVB-to-receiver path. While not being as precise as WWVB, the crystal standard should be close enough to allow locking to the incoming signal, especally if variations in propagation delay prove to be of a slowly changing nature over time.

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*Editor's note: This was Part II of a two-part article by Max Carter. Part I was published in WU#76. Thanks to Max for a fine contribution!*

# WESTERN UPDATE ACTIVE LIST as of November 27, 1990

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Aldrich | Daniel | | | 8030 Petit Verdot Court | Sacramento | CA | 95829 | |
| Anderson | Brice | BA | W9PNE | PO Box 14 | Lancaster | IL | 62855 | (618)299-2441 |
| Armstrong | Lloyd | | | 3813 Lancaster Drive | Pueblo | CO | 81005-3065 | |
| Ashley | Lynn | | | 2401 N. Vernon St. | Arlington | VA | 22207 | (703)522-5308 |
| Bahr | Leland | LEE | W6VT | 914 Golden Bear Lane | Kingwood | TX | 77339-2914 | (713)359-5284 |
| Balfour | Herb | OHH | VE3OHH | 91 Elgin Mills Road West | Richmond Hill (Canada) | ONT | L4C4M1 | (416)884-5355 |
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| Bauer | Frank | FB | W6FPO | PO Box 1086 | Felton | CA | 95018 | (408)335-7392 |
| Bittner | Mike | | | 27215 Sunnyridge Road | Palos Verdes | CA | 90274 | |
| Bond | Robert | | WD6BCN | 1420 McLoughlin Avenue | Oxnard | CA | 93035 | (805)985-0159 |
| Bowers | William | | | Rt. 3, Box 177 AC | Chandler | OK | 74834 | (916)377-4237 |
| Bradley | Dave | | W6CUB | PO Box 2043 | Freedom | CA | 95019-2043 | |
| Bumpus | Carle | | | 930 Idylberry Road | San Rafael | CA | 94903 | |
| Burhans | Ralph | | | 161 Grosvenor Street | Athens | OH | 45701 | (614)593-8207 |
| Burr | David | | | 505 Mackenzie Drive | Lima | OH | 45805 | |
| Buttschardt | Cliff | MPM,HDO, C | W6HDO | 950 Pacific Street | Morro Bay | CA | 93442-2327 | (805)772-2132 |
| Cantrell | Bill | | WD5CVG | Route 1, Box 914 | Haslet | TX | 76052 | |
| Carter | Max | X, MAX | | 46 - 14th Street | Wheatland | WY | 82201 | (307)322-9439 |
| Cathell | Frank | H2, SD | K3YAZ | PO Box 535 | Descanso | CA | 92016 | (619)445-8167 |
| Chappell | Vernon | | | 4511 - 36th Street #6 | San Diego | CA | 92116 | |
| Christianson | Keith | | | 50 North Fourth Street | Old Town | ME | 04468 | |
| Coote | James | J | WB6AAM | 808 North Ave. 66 | Los Angeles | CA | 90042 | (213)258-7490 |
| Confrey | Bob | EDJ | WA1EDJ/4 | 3391 Border Drive | Stone Mountain | GA | 30087 | |
| Cornell | Ken | | W2IMB | 225 Baltimore Avenue | Pt. Pleasant Beach | NJ | 08742 | (908)899-1664 |
| Costa | Bob | | KB6QXM | P.O. Box 600 | Redwood Estates | CA | 95044 | (408)353-3656 |
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| Edwards | Bill | | | PO 1229 | Cowpens | SC | 29330 | |
| Egleston | Allan | | | 20601 Resort Road | Sonora | CA | 95370 | (209)532-7111 |
| Ericson | Jim | EK, EK3 | KG6EK | 226 Charles Street | Sunnyvale | CA | 94086-6063 | (408)773-8947 |
| Farkas | Greg | AZ | AK7Y | PO Box 17074 | Tucson | AZ | 85731-7074 | (602)749-4796 |
| Farnsworth | Charles | | | 506 Rutledge Drive | Lodi | CA | 95240 | |
| Faulkner | Charles | FPV | W6FPV | 15844 McKeever | Granada Hills | CA | 91344 | (818)366-6210 |
| Fisher | Montie | | WA5TSL | 808 Brett Drive | Edmond | OK | 73013 | |
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| Griffith | Anthony | | | 117 White St. | McMinnville | TN | 37110 | |
| Harrington | J. Patrick | | | 4603 Riverdale Road | Riverdale | MD | 20737 | |
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| Herr | George | | | 6690 Vista Del Mar #1 | Playa Del Rey | CA | 90293 | |
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| Johnson | Dave | F, DJ | | 713 Texas Ave. | Los Banos | CA | 93635 | (209)826-0841 |
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